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ACKENHEIL AND ASSOCIATES INC PITTSBURGH PA

NATIONAL DAM INSPECTION PROGRAM. MINE NUMBER 60-POND 5 (NDI NUM—ETC(U)

DACW31-81-C-0027

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LEVEL ✓  
OHIO RIVER BASIN  
TRIBUTARY TO CENTER BRANCH - PIGEON CREEK  
WASHINGTON COUNTY

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PENNSYLVANIA

NDI No. PA 01144  
PENN DER No. 63-88

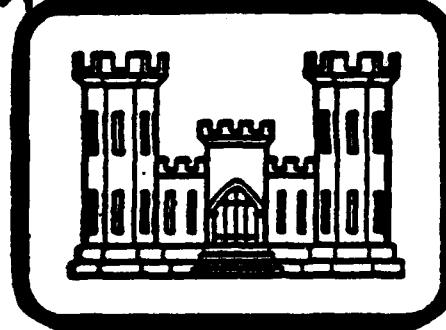
MINE No. 60 - POND 5

BETHLEHEM MINES CORPORATION  
ELLSWORTH - BUTLER DIVISION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DA-GWUS1-81-C-0027 ✓



PREPARED FOR 1

DEPARTMENT OF THE ARMY  
BALTIMORE DISTRICT, CORPS OF ENGINEERS  
BALTIMORE, MARYLAND 21203

BY

ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.  
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MAY 1981

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Phase I Inspection report.

(1) 11/11/81

OHIO RIVER BASIN

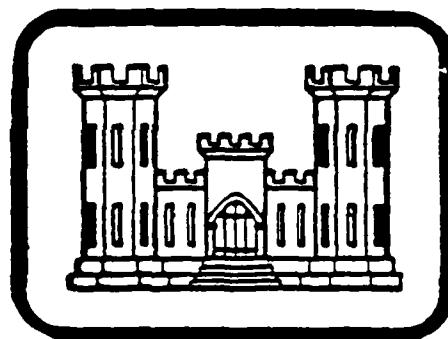
MINE NO. 60-POND 5  
WASHINGTON COUNTY, COMMONWEALTH OF PENNSYLVANIA  
NDI NO. PA 01144  
PennDER NO. 63-88

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BETHLEHEM MINES CORPORATION  
ELLSWORTH-BUTLER DIVISION

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM



11/11/81  
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Prepared for: DEPARTMENT OF THE ARMY  
Baltimore District, Corps of Engineers  
Baltimore, Maryland 21203

Prepared by: ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.  
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Date: May 1981

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## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

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A

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM: Mine No. 60-Pond 5  
STATE LOCATION: Pennsylvania  
COUNTY LOCATION: Washington  
STREAM: Unnamed tributary to Center Branch -  
Pigeon Creek.  
DATE OF INSPECTIONS: 18 March 1981 and 26 March 1981  
COORDINATES: Lat. 40°08'48"  
Long. 80°03'47"

ASSESSMENT

Based on a review of available information and visual observations of conditions as they existed on the date of the field inspections, the general condition of the Mine No. 60-Pond 5 is considered to be fair.

This assessment is based primarily on visual observations of embankment, spillway and seepage conditions and hydrology/hydraulic analyses of reservoir/spillway capacity.

The structure is classified as an "intermediate" size, "high" hazard dam. Corps of Engineers guidelines recommend the Probable Maximum Flood (PMF) as the Spillway Design Flood for an "intermediate" size, "high" hazard dam. The Mine No. 60-Pond 5's Spillway Design Flood is the Probable Maximum Flood. Spillway capacity is "adequate" because the non-overtopping flood discharge was found, by using the HEC-1 computer program, to be in excess of 100 percent of the PMF.

The Phase I investigation of Mine No. 60-Pond 5 revealed deficiencies and conditions which should be corrected or improved through implementation of the following recommended remedial, monitoring and/or improvement efforts.

RECOMMENDATIONS

1. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

a. Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

b. Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)  
Mine No. 60-Pond 5

c. Procedures for drawdown of the reservoir under emergency conditions.

d. Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

2. Remedial Work: The visual inspection disclosed three deficiencies which should be corrected or monitored. These include:

a. Improving the drainage of the embankment crest by removing wheel ruts.

b. Removing the silt fence from the spillway channel and realigning the discharge channel to direct flows away from the right groin.

c. Implementation of a regularly scheduled monitoring program to observe the seepage zones for changes in water quality and/or quantity.

3. Abandonment: As an alternative to the recommendations presented above, the owner should develop and implement a plan to make the facility incapable of impounding water. Such an abandonment plan should conform to all applicable local, state and federal regulations, and all regulatory approvals should be obtained prior to the start of abandonment construction operations.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)  
Mine No. 60-Pond 5

Samuel G. Mazzella 8 May 1981  
Samuel G. Mazzella Date  
Project Engineer



James P. Hannan 8 May 1981  
James P. Hannan Date  
Project Engineer

James E. Barrick 8 May 1981  
James E. Barrick, P.E. Date  
PA Registration No. 022639-E

Approved by:

James W. Peck  
James W. Peck, Colonel  
Corps of Engineers  
District Engineer

22 May 81  
Date

MINE No. 60 - POND 5



OVERVIEW

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PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
MINE NO. 60-POND 5  
NATIONAL I. D. NO. PA 01144  
PennDER No. 63-88

SECTION 1  
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances:

(1) Embankment: The Mine No. 60-Pond 5 embankment was constructed as a earthfill structure. The embankment is 1100 feet long, with a toe to crest height of 78.7 feet and a crest width of about 20 feet. The embankment's upstream slope was measured to be 2.9H:1V above the waterline; the downstream slope was measured to vary from 3.0H:1V to 2.8H:1V.

(2) Principal (and Emergency) Spillway: The principal (and emergency) spillway for the Mine No. 60-Pond 5 consists of a 12 foot wide trapezoidal open channel in the right abutment. A silt fence is located across the spillway crest.

(3) Outlet Works: An outlet works consisting of a submerged pump and pipeline is located near the upstream end of the impoundment. The partially clarified pond water is returned to the Mine No. 60 Preparation Plant for reuse in the coal cleaning process.

(4) Freeboard Conditions: Freeboard between the low point on the embankment and the spillway crest is 2.6 feet.

(5) Downstream Conditions: The unnamed creek below the Mine No. 60-Pond 5 flows through an uninhabited valley for about 1.4 miles to a confluence with the Center Branch of Pigeon Creek. Pigeon Creek flows into the Monongahela River near Monongahela, Pennsylvania. In the first 5 miles below the dam, at least 5 inhabited dwellings, several major secondary roads, a railyard and a reservoir lie within the limits of the affected floodplain.

(6) Reservoir: The Mine No. 60-Pond 5 is about 700 feet long at the operating pool elevation and has a surface area of 11.2 acres. When the pool is at the crest of the dam, the reservoir length increases to 750 feet and the surface area would be about 11.9 acres.

(7) Watershed: The watershed contributing to the Mine No. 60-Pond 5 is a woodland. The watershed, 32 acres, is completely owned by the Bethlehem Mines Corporation.

b. Location: Mine No. 60-Pond 5 is located at the head-waters of an unnamed tributary to the Center Branch of Pigeon Creek, in Somerset Township, Washington County, Pennsylvania. The pond is approximately 3 miles northwest of Ellsworth, Pennsylvania.

c. Size Classification: The dam has a maximum storage capacity of 217 acre-feet and a toe to crest height of 78.7 feet. Based on the Corps of Engineers guidelines, this dam is classified as an "intermediate" size structure.

d. Hazard Classification: The Mine No. 60-Pond 5 is classified as a "high" hazard dam. In the event of a dam failure, at least 5 inhabited dwellings, several roads, a rail-yard and a reservoir could be subjected to substantial damage and the loss of more than a few lives could result.

e. Ownership: The No. Mine 60-Pond 5 is owned by the Bethlehem Mines Corporation. Correspondence can be addressed to:

Bethlehem Mines Corporation  
Ellsworth-Butler Division  
P. O. Box 143  
Eighty-Four, Pennsylvania 15330  
Attention: Mr. D. F. Patterson, Chief Engineer  
(412) 228-5500

f. Purpose of Dam: The Mine No. 60-Pond 5 was constructed to serve as a holding and settling impoundment for fine coal refuse slurry from the Mine No. 60 Coal Preparation Plant.

g. Design and Construction History: The dam was designed by Bethlehem Mines Corporation, Ellsworth-Butler Division and was constructed in two stages. Stage I was placed to Elevation 1150 during the Summer of 1972 and Stage II was raised to Elevation 1175 during the Summer of 1975. Construction work was performed by Patsy Boccabello and Sons, Inc., of Bentleyville, Pennsylvania.

h. Normal Operating Procedure: The Mine No. 60-Pond 5 was designed to operate as an uncontrolled structure. Under normal operating conditions, the operating pool level is maintained by the outlet works. A spillway provides for a maximum operating pool elevation of about 1172.5.

Inflow to the Mine No. 60-Pond 5 includes runoff from the watershed above and fine coal refuse slurry from the Mine No. 60 Preparation Plant.

### 1.3 PERTINENT DATA

|  |               |
|--|---------------|
| a. <u>Drainage Area</u>                | 0.05 sq. mi.  |
| b. <u>Discharge</u>                    |               |
| Maximum flood at Dam Facility          | Unknown       |
| Spillway Capacity at Top of Dam        | 155 cfs       |
| c. <u>Elevation (feet above MSL)</u>   |               |
| Design Top of Dam                      | Unknown       |
| Current Top of Dam (low point)         | 1175.1        |
| Spillway Crest                         | 1172.5        |
| Operating Pool (on date of inspection) | 1172.5        |
| Toe of Embankment                      | 1096.4        |
| d. <u>Reservoir Length</u>             |               |
| Length of Maximum Pool                 | 750 feet      |
| Length of Operating Pool               | 700 feet      |
| e. <u>Reservoir Storage</u>            |               |
| Design Top of Dam                      | Unknown       |
| Current Top of Dam                     | 217 acre-feet |
| Spillway Crest                         | 187 acre-feet |
| f. <u>Reservoir Surface</u>            |               |
| Design Top of Dam                      | Unknown       |
| Current Top of Dam                     | 11.9 acres    |
| Spillway Crest                         | 11.2 acres    |

g. Embankment

|                   |                     |
|-------------------|---------------------|
| Type              | Earth               |
| Length            | 1100 feet           |
| Height            | 78.7 feet           |
| Crest Width       | 20 feet             |
| Slopes            |                     |
| Downstream        | 3.0H:1V to 2.8 H:1V |
| Upstream          | 2.9 H:1V            |
| Impervious Core   | Unknown             |
| Cutoff Provisions | Unknown             |
| Grout Curtain     | Unknown             |

h. Emergency Spillway

|                       |                          |
|-----------------------|--------------------------|
| Type                  | Trapezoidal Open Channel |
| Location              | Right Abutment           |
| Overflow Crest Length | 12 feet                  |
| Crest Elevation       | 1172.5 feet              |

i. Outlet Works

|          |                                  |
|----------|----------------------------------|
| Type     | Submerged Pump                   |
| Location | Near Upstream End of Impoundment |

SECTION 2  
ENGINEERING DATA

2.1 DESIGN

a. Data Available: The files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), were reviewed but no engineering data relating to the original design of the facility were found.

All available design and construction information was obtained from representatives of Bethlehem Mines Corporation.

b. Design History: The dam was designed by Bethlehem Mines Corporation, Ellsworth-Butler Division in 1972. The owner provided the topographic drawing listed in Appendix B and reproduced in Appendix E.

2.2 CONSTRUCTION

Mine No. 60-Pond 5 were constructed in two stages by Patsy Boccabello and Sons, Inc. of Bentleyville, Pennsylvania. Stage I to Elevation 1150 was placed during the Summer of 1972 and Stage II to Elevation 1175 was placed in 1975.

2.3 OPERATION

The dam is designed to operate without a dam tender. The principal (and emergency) spillway is a 12 foot wide trapezoidal open channel in the right abutment.

The outlet works is an electric motor driven pump which returns partially clarified pond water to the Mine No. 60 Preparation Plant. There is no information available on the operation of the outlet works pump system.

Performance and operation records are not maintained. The impoundment zone is almost filled with fine coal refuse sediments.

2.4 EVALUATION

a. Availability: There was no engineering data available in the files of PennDER, Bureau of Dams and Waterway Management. The owner provided the topographic map listed in Appendix B and reproduced in Appendix E.

b. Adequacy: The limited available engineering information, was supplemented by field inspections and supporting engineering analyses and is considered adequate for the purpose of this Phase I Inspection Report.

c. Validity: Based on the review of the available information, there appears to be no reason to question the validity of the limited available engineering data.

SECTION 3  
VISUAL INSPECTION

3.1 FINDINGS

a. General: The field inspection of Mine No. 60-Pond 5 was performed on 18 March 1981 and 26 March 1981 and consisted of:

- (1) Visual observations of the embankment crest and slopes, groins and abutments;
- (2) Visual observations of the principal (and emergency) spillway including approach channel, overflow crest, and discharge channel;
- (3) Visual observations of the embankment's downstream toe area including drainage channels and surficial conditions;
- (4) Visual observations of downstream conditions and evaluation of the downstream hazard potential;
- (5) Visual observations of the reservoir shoreline and watershed;
- (6) Visual observations of the outlet works;
- (7) Transit stadia surveys of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes.

The visual observations were made during periods when the reservoir was at normal operating level.

The visual observations checklist, field sketch, field sections, and details containing the observations and comments of the field inspection team are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the field inspection are presented in the following sections.

b. Embankment:

(1) Crest: The crest of the embankment was generally straight and level throughout its length. No offsets or indications of misalignment were observed that would indicate anomalous movement of the embankment. The crest was lightly vegetated, and contained a number of barren areas including wheel ruts, some of which contained standing water.

(2) Upstream Slope: The upstream slope was densely vegetated with grass and brush. There were no indications of erosion or slope instability on the upstream slope.

(3) Downstream Slope: The downstream slope was generally uniform and completely covered with a thick stand of grass and small brush. The slope was generally uniform from toe to crest and from abutment to abutment. No sloughs, scarps or significant bulges were observed on the downstream slope.

The embankment groins (junction of embankment and abutment) were in good condition. They were heavily vegetated and there were no indications of erosion or instability.

c. Abutments: Both abutments were cleared of trees and contained only grass and brush. There were no signs of slope instability, seepage, or significant erosion of either abutment.

d. Seepage: Two seepage zones were observed in the immediate vicinity of the downstream toe of the embankment.

The first zone was approximately half way between the embankment crest and the valley bottom. The seepage emanated from a spring located in soil materials in a small depression in the groin; "blackwater" staining and deposition of very fine coal refuse sediments were observed immediately below the discharge point. Some swamp type vegetation was noted in the immediate vicinity of the spring as well as along the drainage channel that carried the flow over the left abutment to the valley bottom below. The spring flow was visually estimated to be less than 1/2 gallon per minute.

The second seepage zone was in the valley bottom immediately below the toe of the embankment. The seepage flow was less concentrated than above and appeared to emanate from soil materials. Considerable swamp type vegetation was growing in the vicinity and the local soils were generally very soft. No "blackwater" staining was observed.

Total seepage flow below the dam was estimated visually to be 1 to 2 gallons per minute, including the flow from the spring described above.

e. Principal (and Emergency) Spillway:

(1) Approach Channel: The approach channel to the spillway did not contain any significant obstructions that might reduce the capacity of the spillway during high flows.

(2) Overflow Crest: The overflow crest of the spillway contained a silt fence designed to separate the fine coal refuse from discharging flows. The fence would probably be a significant obstruction to low flows but would be washed away by higher flows in the spillway.

(3) Discharge Channel: The discharge channel crosses the right abutment and discharges to the abutment slope above the toe of the embankment. The channel was partially vegetated with grass and brush but did not appear to be eroded or unstable.

f. Outlet Works: The outlet works consists of a 1,000 gallon per minute pump feeding a six inch (nominal) diameter steel pipe. The system is designed to return partially clarified pond water to the Ellsworth Mine No. 60 Preparation Plant for reuse in the coal preparation process.

g. Reservoir:

(1) Slopes: The slopes of the reservoir were observed to be generally mild to moderately steep and were barren to grass and brush covered. There were no indications of significant slope instability or erosion anywhere within the impoundment zone.

(2) Inlet Stream: Because of the location of the reservoir at the upper end of the watershed, there is no defined inlet stream to Pond 5.

(3) Sedimentation: Pond 5 is almost full of fine coal refuse sediments deposited by a pipeline from the Ellsworth Mine No. 60 Coal Preparation Plant.

(4) Watershed: The watershed contributing to Pond 5 is quite small and entirely undeveloped. It is almost completely wooded.

h. Downstream Conditions:

(1) Channel: The downstream channel for Pond 5 flows through an undeveloped valley for a distance of approximately 1.3 miles. In this reach, it passes beneath three township roads and a railyard at Mine No. 60. The channel joins the Center Branch of Pigeon Creek approximately 1.4 miles below the dam.

(2) Floodplain Conditions: In the first five miles below Pond 5 at least five inhabited dwellings lie on the floodplain at elevations low enough to possibly be affected by high flows.

### 3.2 EVALUATION

The following evaluations are based on the results of the visual inspections performed on 18 March and 26 March 1981.

a. Embankment: The condition of Mine No. 60-Pond 5 embankment was good. No deficiencies were observed anywhere on the upstream or downstream slopes of the embankment. Minor wheel rutting with some standing water was observed on the crest.

b. Principal (and Emergency) Spillway: The spillway was considered to be in poor condition. This is based on the observed silt fence obstruction in the channel and the discharge channel alignment that directs spillway flows into the embankment's right groin.

c. Seepage Zones: The two seepage zones below the embankment appeared to be stable in terms of discharge water quality and quantity. Neither seepage zone appeared to pose an immediate threat to the dam. Although the upper zone (spring fed) showed "blackwater" stains and deposition of very fine coal refuse sediments immediately below the discharge point, the condition did not appear to represent an active deficiency. In the lower zone, no discolored flows, sediment deposits, or recent erosion were observed.

SECTION 4  
OPERATIONAL FEATURES

**4.1 PROCEDURE**

Reservoir pool level is maintained by the overflow crest of the principal (and emergency) spillway.

The outlet works consists of a submerged pump system which draws off the partially clarified pond water and returns it to the Mine No. 60 Preparation Plant.

There are no reported pipes through the embankment. Fine coal refuse slurry is pumped to the facility through a 6 inch pipe that discharges into the pond near the center of the embankment.

Normal operating procedure does not require a dam tender.

**4.2 MAINTENANCE OF DAM**

The embankment and appurtenances are maintained by the Bethlehem Mines Corporation. Maintenance reportedly consists of periodically repairing eroded areas and making miscellaneous repairs as necessary.

**4.3 INSPECTION OF DAM**

The Bethlehem Mines Corporation is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

The Bethlehem Mines Corporation is required by the Mine Safety and Health Administration (MSHA) to inspect the dam at least once every seven days and to make an annual report and certification of the dam.

**4.4 WARNING PROCEDURE**

There is no warning system and no formal emergency procedure to alert or evacuate downstream residents upon threat of a dam failure.

**4.5 EVALUATION**

The maintenance program should be continued. However, there are no written operation, maintenance or inspection procedures, nor is there a warning system or formal emergency procedure for this dam. These procedures should be developed in the form of checklists and step by step instructions, and should be implemented as necessary.

SECTION 5  
HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: The Mine No. 60-Pond 5 has a watershed of 32 acres which is vegetated primarily by woodland. The watershed is about 1,400 feet long and 1,200 feet wide and has a maximum elevation of 1,240 feet (MSL).

The impoundment is used to settle out the fines from a coal preparation plant slurry.

At the emergency spillway crest elevation (maximum operating pool) 1172.5, the pond has a surface area of 11 acres and a storage capacity of 187 acre-feet. The emergency spillway consists of a grass lined trapezoidal open channel in the right abutment. The spillway has a 12 foot base width and side slopes of 2.7H:1V and 4.1H:1V.

There was no information available on the design capacity requirements of the spillway and no hydrologic calculations were found relating reservoir/spillway performance to the Probable Maximum Flood (PMF) or fractions thereof.

b. Experience Data: Records are not kept of reservoir level or rainfall amounts. There is no record or report of the embankment ever being overtopped.

c. Visual Observations: On the date of the field inspection, a silt fence was observed in the overflow crest area of the spillway. The fence appeared capable of obstructing low flows but would probably be destroyed by higher flows. Only a subjective evaluation of its effect could be made. Its existence was not considered in the HEC-1 analysis.

The pool elevation at the time of the inspection was about 2.6 feet below the crest of the dam.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend the Probable Maximum Flood (PMF) as the Spillway Design Flood (SDF) for "intermediate" size, "high" hazard dams.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.4 inches. No calculations are available to indicate whether the reservoir and spillway are sized to pass a flood corresponding to the runoff from 19.4 inches of rainfall in 24 hours. Consequently, an evaluation of the reservoir/spillway system was performed to determine whether the dam's spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July 1978. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to the Mine No. 60-Pond 5 was determined by HEC-1 to be 204 cfs for a full PMF (and SDF).

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be 155 cfs which is in excess of 100% of the PMF calculated by HEC-1. According to Corps of Engineers' guidelines, the combined reservoir/spillway capacity of the Mine No. 60-Pond 5 is "adequate".

## SECTION 6 STRUCTURAL STABILITY

### 6.1 AVAILABLE INFORMATION

a. Design and Construction Data: No design documentation or calculations were available for review. The owner provided the topographic map that is cited in Appendix B and presented in Appendix E.

b. Operating Records: There are no written operating records or procedures for this dam.

#### c. Visual Observations:

(1) Embankment: The field inspection disclosed no evidence of a high ground water level in the embankment. There was no pronounced "line of seepage"; and no significant bulges, surface sloughs, or cracking were observed. Two seepage zones were observed in the vicinity of the toe of the embankment. The zones contained soft and swampy conditions and a small amount of seepage was flowing from each zone. Field measurements indicated a relatively flat downstream slope varying from 3.0H:1V near the crest, to 2.8H:1V near the toe.

The embankment's upstream slope was densely vegetated with grass and brush. There were no indications of erosion or slope instability.

(2) Principal (and Emergency) Spillway: The spillway was partially vegetated with grass and brush and did not appear to be eroded or unstable.

d. Performance: No information was available on performance of Mine No. 60-Pond 5 since its construction in 1972.

### 6.2 EVALUATION

a. Design Documents: No design documentation was available to evaluate the structure.

b. Embankment: Based on the results of the visual observations of embankment slopes, materials and seepage conditions, Mine No. 60-Pond 5 appears to have an adequate margin of safety against sliding.

The two seepage zones observed at the toe of the downstream slope do not appear to constitute an immediate threat to the dam.

c. Principal (and Emergency) Spillway: Structurally, the spillway appeared to be functional.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Mine No. 60-Pond 5 is located in Zone 1 where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. No calculations were developed to verify this assessment, however.

SECTION 7  
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Mine No. 60-Pond 5's embankment is considered to be in good condition. This is based on visual observations that revealed only minor deficiencies.

(2) Principal (and Emergency) Spillway: The spillway is considered to be in poor condition. This is based on an obstruction in the overflow crest area and a poor alignment that directs discharge channel flows into the right downstream groin.

The Spillway Design Flood for Mine 60-Pond 5 was the Probable Maximum Flood. The combined reservoir spillway capacity was determined by HEC-1 to be in excess of 100% of the PMF.

(3) Seepage Zones: The seepage zones at the downstream toe of the embankment represent potential deficiencies if changes in water quality and quantity should occur. On the date of the field inspection, however, there were no indications that these zones pose an immediate threat to the dam.

(4) Emergency Plans: The lack of a documented emergency operation and warning plan is considered to be a deficiency.

b. Adequacy of Information: The information available on design, construction, operation and performance history in combination with visual observations and hydrology and hydraulic calculations was sufficient to evaluate the embankment and appurtenant structures in accordance with the Phase I investigation guidelines.

c. Urgency: The recommendations presented in Section 7.2a and 7.2b should be implemented immediately.

d. Necessity for Additional Studies: None.

7.2 RECOMMENDATIONS

a. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

b. Remedial Work: The visual inspection disclosed three deficiencies which should be corrected or monitored. These include:

(1) Improving the drainage of the embankment crest by removing wheel ruts.

(2) Removing the silt fence from the spillway channel and realigning the discharge channel to direct flows away from the right groin.

(3) Implementation of a regularly scheduled monitoring program to observe the seepage zones for changes in water quality and/or quantity.

c. Abandonment: As an alternative to the recommendations presented above, the owner should develop and implement a plan to make the facility incapable of impounding water. Such an abandonment plan should conform to all applicable local, state and federal regulations; and all regulatory approvals should be obtained prior to the start of abandonment construction operations.

APPENDIX A  
VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I  
 (NON-MASONRY IMPOUNDING STRUCTURE)

|                                      |                      |           |        |                   |                 |                     |               |                 |
|--------------------------------------|----------------------|-----------|--------|-------------------|-----------------|---------------------|---------------|-----------------|
| Name of Dam                          | Mine No.             | 60-Pond 5 | County | <u>Washington</u> | State           | <u>Pennsylvania</u> | National ID # | <u>PA 01144</u> |
| Type of Dam                          | Earth                |           |        |                   | Hazard Category | High                |               |                 |
| Dates of Inspection                  | 18 March 1981        |           |        |                   | Weather         | Partly cloudy, cool | Temperature   | <u>35°F</u>     |
|                                      | <u>26 March 1981</u> |           |        |                   |                 | Partly cloudy, mild |               | <u>50°F</u>     |
| Pool Elevation at Time of Inspection | <u>1172.5</u>        | (MSL)     |        |                   |                 |                     |               |                 |
| Tailwater at Time of Inspection      | <u>None</u>          |           |        |                   |                 |                     |               |                 |

Inspection Personnel: 18 March 1981

J. P. Hannan  
 S. G. Mazzella  
 Ackenheil & Associates, Geotechnical Engineer  
 Ackenheil & Associates, Civil Engineer

26 March 1981  
 J. E. Barrick, P.E.  
 Ackenheil & Associates, Project Manager  
 and Hydrologist

Recorder J. E. Barrick

EMBANKMENT

| VISUAL EXAMINATION OF  | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|--|---|----------------------------|
| SURFACE CRACKS   | None observed.  |                            |
| UNUSUAL MOVEMENT OR<br>CRACKING AT OR BEYOND<br>THE TOE      | None observed.  |                            |
| SLoughing or Erosion of<br>embankment and abutment<br>slopes | None observed.  |                            |
| Vertical and Horizontal<br>Alignment of the crest            | The embankment crest was straight and approximately level throughout its length. The crest pitched slightly toward the impoundment near the left end of the embankment. |                            |
| Riprap Failures  | None observed.  |                            |
| Settlement   | None observed.  |                            |

EMBANKMENT (CONTINUED)

| <u>VISUAL EXAMINATION OF</u>        | <u>OBSERVATIONS</u>   | <u>REMARKS OR RECOMMENDATIONS</u> |
|-------------------------------------|---|-----------------------------------|
| JUNCTION OF EMBANKMENT AND ABUTMENT | Both embankment groins appeared to be in good condition. No erosion, seepage, or unstable conditions were noted along either the right groin. A seepage zone was located in the left groin as discussed under "Any Noticeable Seepage" below.   |                                   |
| JUNCTION OF EMBANKMENT AND SPILLWAY | No junction exists. Spillway is excavated entirely into natural ground of the right abutment.   |                                   |
| ANY NOTICEABLE SEEPAGE              | Two zones of seepage were observed just beyond the downstream toe of the embankment. The first zone was located approximately halfway between the valley bottom and the embankment crest in a small depression at the embankment groin. Some water-related vegetation was growing in the vicinity. Flow from a spring in the area was visually estimated to be less than 1/2 gallon per minute. "Blackwater" staining and deposition of very fine coal refuse sediments were observed immediately below the spring. |                                   |

The second seepage zone was located in the valley bottom just beyond the toe of the dam. Considerable cattails and water-related vegetation were growing in the vicinity, and soils were observed to be very soft. Flow from this area was more diffuse than above and was estimated to be 1 to 2 gallons per minute, including the flow from the spring discussed above. No flow discoloration or sedimentation indicative of movement of fine soil particles was observed in the vicinity of the lower seepage zone.

EMBANKMENT (CONTINUED)

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u>  | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|--|-----------------------------------|
| STAFF GAUGE AND RECORDER     | None observed.   |                                   |
| DRAINS                       | None observed.   |                                   |
| SURFICIAL CONDITIONS         | The embankment crest was partially vegetated by grass and small brush. Barren spots were observed and several areas contained wheel ruts, some with ponded water.  |                                   |
|                              | The upstream slope of the embankment was densely vegetated with grass and brush. There were no signs of erosion or instability of the upstream slope.  |                                   |
|                              | The downstream slope was generally uniform from toe to crest and abutment to abutment. Some local unevenness was noted, including a disturbed area near the center of the embankment, at the crest, that appeared to be the result of heavy equipment moving on the embankment slope. In general, the downstream slope was densely vegetated by grass and brush. There were no signs of erosion or slope instability anywhere on the downstream slope. |                                   |

PRINCIPAL (AND EMERGENCY) SPILLWAY

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u>  | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|--|-----------------------------------|
| APPROACH CHANNEL             | The approach channel was clear of obstructions that might hinder performance of the spillway during high flows.  |                                   |
| OVERFLOW SECTION             | The overflow section contained a silt fence constructed of reinforcing rod fence posts that supported a fabric filter material designed to filter fine coal refuse from water discharging through the spillway. The silt fence did not appear substantial enough to withstand high flows in the spillway. However, lower flows could be significantly retarded by the fence. |                                   |
| DISCHARGE CHANNEL            | The discharge channel is an open ditch that crosses the right abutment and discharges directly to the hillside above the toe of the dam. The channel was partially vegetated on the date of inspection, but there were no signs of significant erosion or channel side slope instability.  |                                   |

OUTLET WORKS

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u>  | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|--|-----------------------------------|
| PUMP                         | Water is removed from Pond 5 by a pump located at the rear of the reservoir. The pump is a 75 horsepower, 1000-gallon-per-minute unit which supplies a 6" diameter (nominal) steel pipeline. The water is returned to the Ellsworth Mine No. 60 preparation plant for reuse in the coal preparation process. |                                   |

INSTRUMENTATION

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|---------------------|-----------------------------------|
| MONUMENTATION/SURVEYS        | None observed.      |                                   |
| WEIRS                        | None observed.      |                                   |
| PIEZOMETERS                  | None observed.      |                                   |
| OBSERVATION WELLS            | None observed.      |                                   |

RESERVOIR

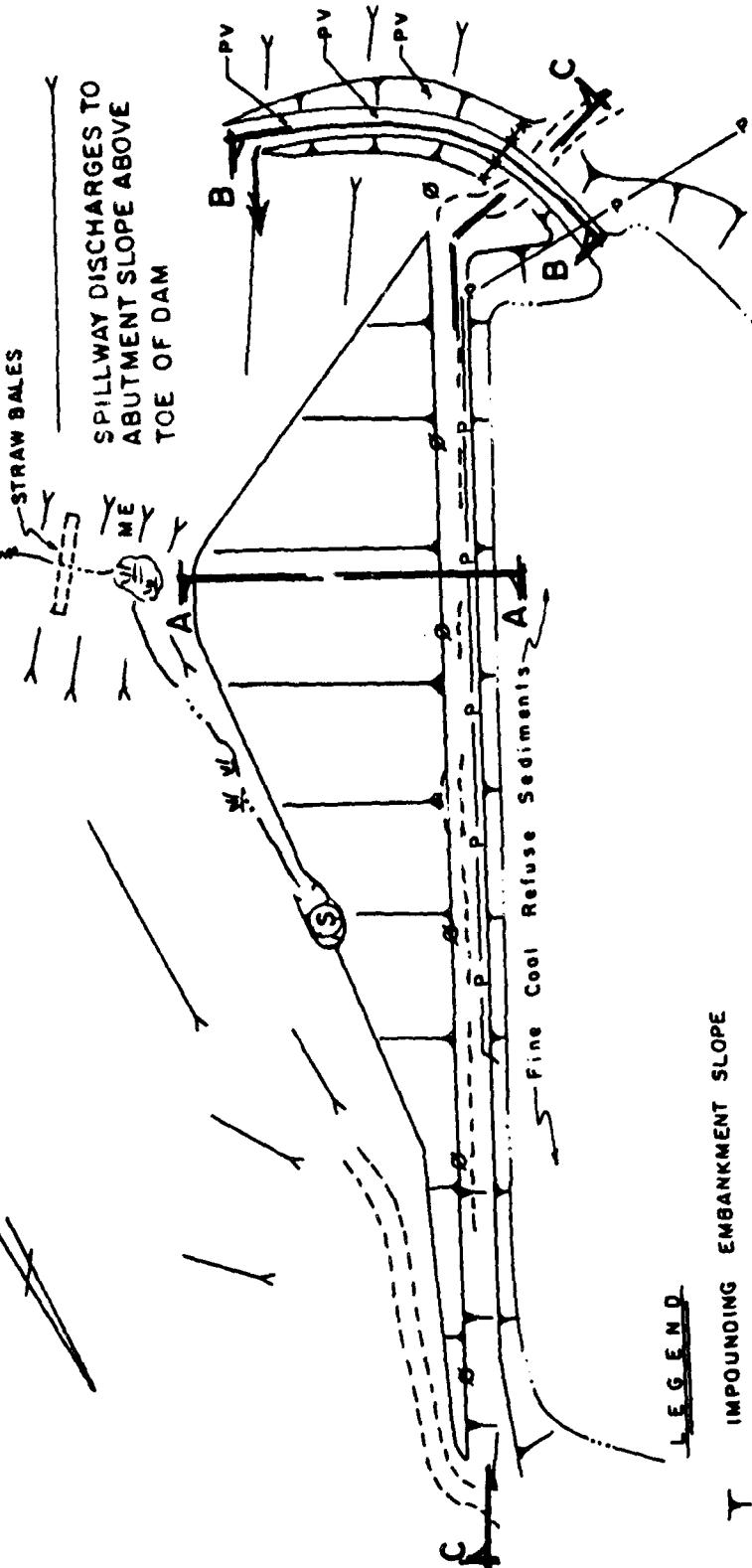
| VISUAL EXAMINATION OF | REMARKS OR RECOMMENDATIONS  |
|-----------------------|---|
| SLOPES                | The reservoir slopes were mild to moderately steep, and were either barren, grass-, or brush-covered. There were no signs of significant slope instability anywhere within the limits of the impoundment. |
| SEDIMENTATION         | Pond 5 is almost full of fine coal refuse sediments.  |
| INLET STREAM          | Pond 5 is located very high in the watershed and has no defined inlet stream.   |
| WATERSHED             | On the day of inspection, the watershed for Pond 5 was completely undeveloped and entirely wooded. The watershed is extremely small, extending only to the ridge line immediately behind the pond.        |

DOWNSTREAM CONDITIONS

| <u>VISUAL EXAMINATION OF</u>                  | <u>OBSERVATIONS</u>  | <u>REMARKS OR RECOMMENDATIONS</u>   |
|---|--|---|
| CHANNEL<br>(OBSTRUCTIONS,<br>DEBRIS, ETC.)    | The downstream channel passes through an uninhabited valley for approximately 1.4 miles where it joins the Center Branch of Pigeon Creek. In this reach, the creek passes beneath three township roads and a Conrail railyard below the Mine No. 60 complex. | Approximately three miles below the dam, Center Branch joins Pigeon Creek. At 3.5 miles, Pigeon Creek enters a reservoir above the Ellsworth Mine No. 51 complex on the outskirts of Ellsworth, Pennsylvania. |
| APPROXIMATE NUMBER<br>OF HOMES AND POPULATION |  | In the first five miles below Pond 5, there are at least five inhabited dwellings that lie at elevations low enough to possibly be affected by high flows in Pigeon Creek.                                    |

TOTAL ESTIMATED  
SEEPAGE 1102 G.P.M.

SPILLWAY DISCHARGES TO  
ABUTMENT SLOPE ABOVE  
TOE OF DAM



- NOTES
1. SEE DRAWING 80138F-2 FOR FIELD SECTIONS A-A AND B-B
  2. SEE DRAWING 80138F-3 FOR FIELD SECTION C-C AND SPILLWAY DETAIL

LEGEND

|                                    |
|------------------------------------|
| <u>IMPOUNDING EMBANKMENT SLOPE</u> |
| <u>OTHER SLOPES</u>                |
| <u>STREAM OR SHORELINE</u>         |
| <u>MINOR EROSION</u>               |
| <u>PARTIALLY VEGETATED</u>         |
| <u>UTILITY POLE</u>                |
| <u>WHEEL RUTS</u>                  |
| <u>DEPRESSION</u>                  |
| <u>SWAMP OR MARSH</u>              |
| <u>Pipeline</u>                    |
| <u>Fence</u>                       |
| <u>Spring</u>                      |

DATE: MAY 1981

SCALE: NONE

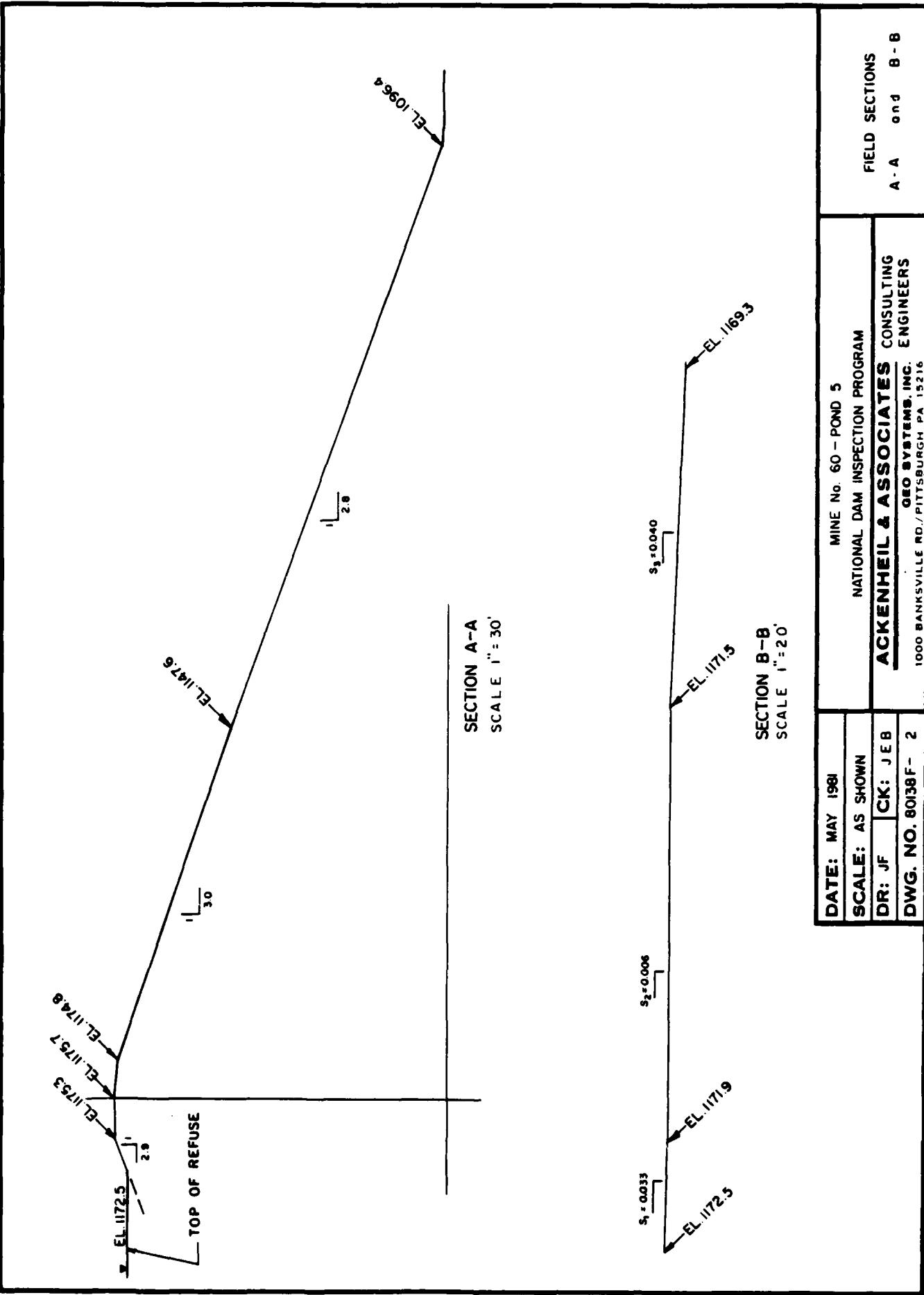
DR: JF CK: JEB

DWG. NO. 80138F-1

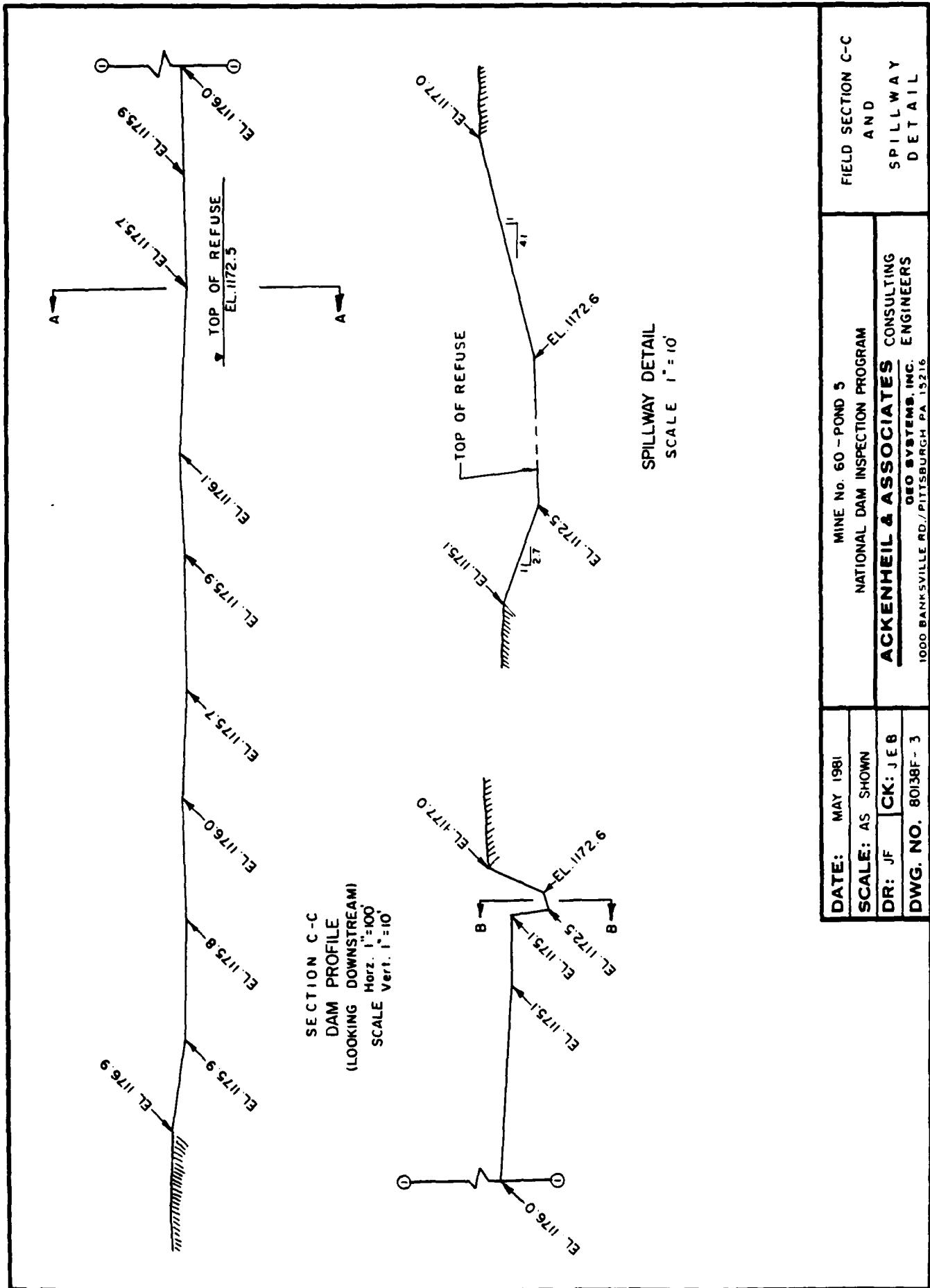
MINE No. 60 - POND 5  
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING  
GEO SYSTEMS, INC. ENGINEERS  
1000 BANKSVILLE RD / PITTSBURGH, PA 15216

FIELD  
SKETCH



|                    |  |
|--------------------|--|
| DATE: MAY 1981     | MINE NO. 60 - POND 5                         |
| SCALE: AS SHOWN    | NATIONAL DAM INSPECTION PROGRAM              |
| DR: JF CK: JEB     | <b>ACKENHEIL &amp; ASSOCIATES</b> CONSULTING |
| DWG. NO. 60138F- 2 | GEO SYSTEMS, INC. ENGINEERS                  |
|                    | 1000 BANKSVILLE RD / PITTSBURGH, PA 15216    |



|          |          |
|----------|----------|
| DATE:    | MAY 1981 |
| SCALE:   | AS SHOWN |
| DR:      | JF       |
| DWG. NO. | 80138F-3 |

|  |
|--|
| MINE No. 60 - POND S                     |
| NATIONAL DAM INSPECTION PROGRAM          |
| <b>ACKENHEIL &amp; ASSOCIATES</b>        |
| CONSULTING ENGINEERS                     |
| GEO SYSTEMS, INC.                        |
| 1000 BANKSVILLE RD / PITTSBURGH PA 15216 |

APPENDIX B  
ENGINEERING DATA CHECKLIST

CHECK LIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE I

NAME OF DAM Mine No. 60-Pond 5  
 NDI No. PA 01144

| ITEM   | REMARKS  |
|--|--|
| Design Drawings  | None available.  |
| As-Built Drawings  | None available.  |
| Regional Vicinity Map                                    | U.S.G.S. 7-1/2 minute Hackett, Pennsylvania Quadrangle Map.  |
| *Construction History                                    | Constructed in stages by Patsy Boccabella and Sons, Inc., Bentleyville, Pennsylvania between 1972 and 1975.<br><br>Stage I to Elevation 1150 completed in 1972.<br>Stage II to Elevation 1975 completed in 1975. |
| Typical Sections of Dam                                  | None available.  |
| Outlets-Plan Details<br>Constraints<br>Discharge Ratings | None available.  |
| Rainfall/Reservoir Records                               | None available.  |

| ITEM  | REMARKS  |
|---|--|
| Design Reports  | None available.  |
| Geology Reports   | None available.  |
| Design Computations   | None available.  |
| Hydrology and Hydraulics  | None available.  |
| Dam Stability   | None available.  |
| Seepage Studies   | None available.  |
| Materials Investigations,<br>Boring Records,<br>Laboratory, Field | None available.  |
| *Post-Construction Surveys of Dam                                 | See topographic map of Mine 60, Lake Calydon,<br>November 1978. ** |
| Borrow Sources  | Data not available.  |
| Monitoring Systems  | None available.  |
| Modifications   | None reported.   |

| ITEM   | REMARKS                              |
|--|--------------------------------------|
| High Pool Records                                      | None reported.                       |
| Post-Construction Engineering Studies and Reports      | None available.                      |
| Maintenance/Operation Records                          | None available.                      |
| Spillway - Plan Sections Details                       | None available.                      |
| Operating Equipment Plans and Details                  | None available.                      |
| Specifications   | None available.                      |
| Miscellaneous  | No additional information available. |
| Prior Accidents or Failure of Dam, Description Reports | None.                                |

\*Drawings obtained from Bethlehem Mines Corporation, Ellsworth-Butler Division.  
 \*\*Reduced size reproductions contained in Appendix E.

APPENDIX C  
PHOTOGRAPHS

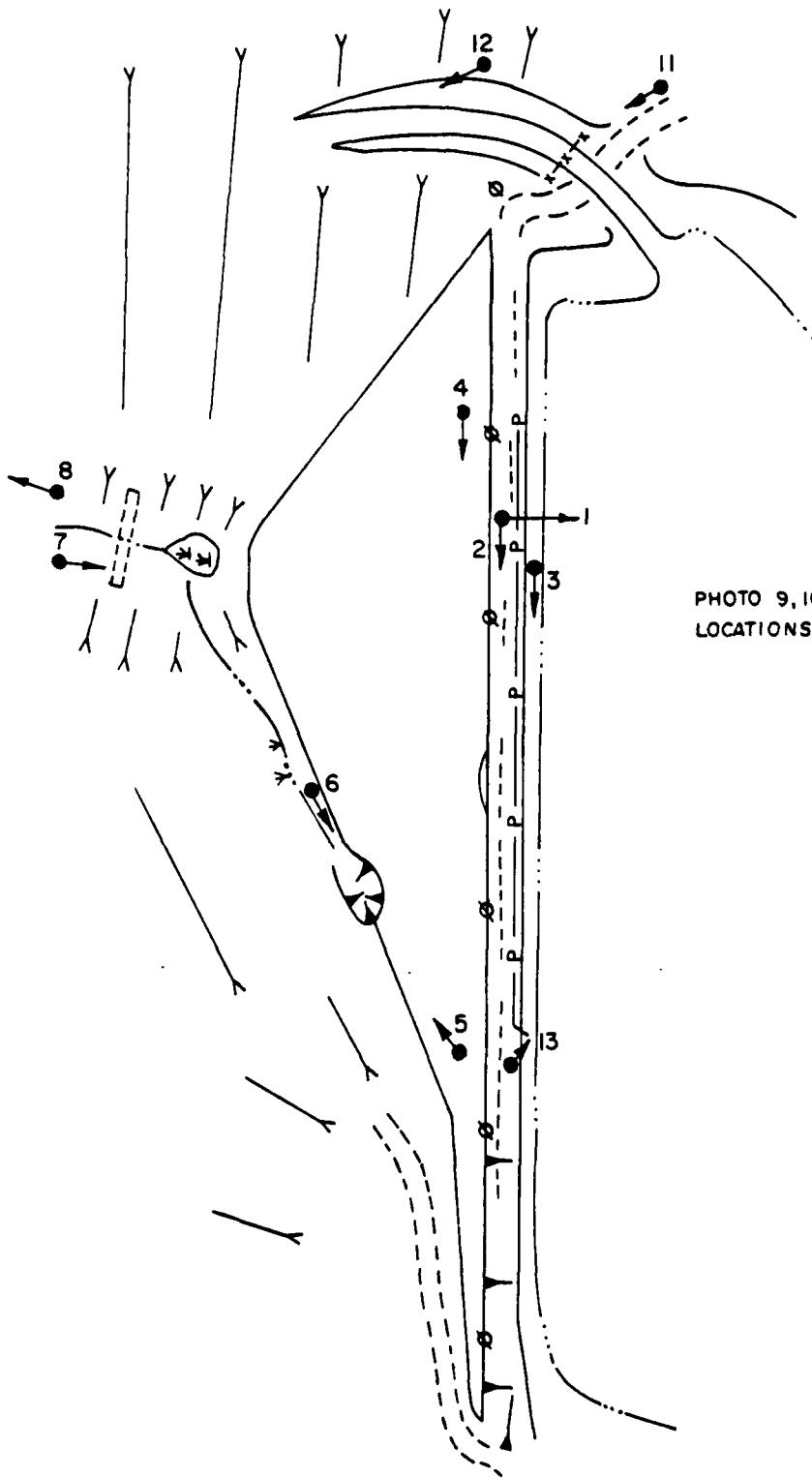


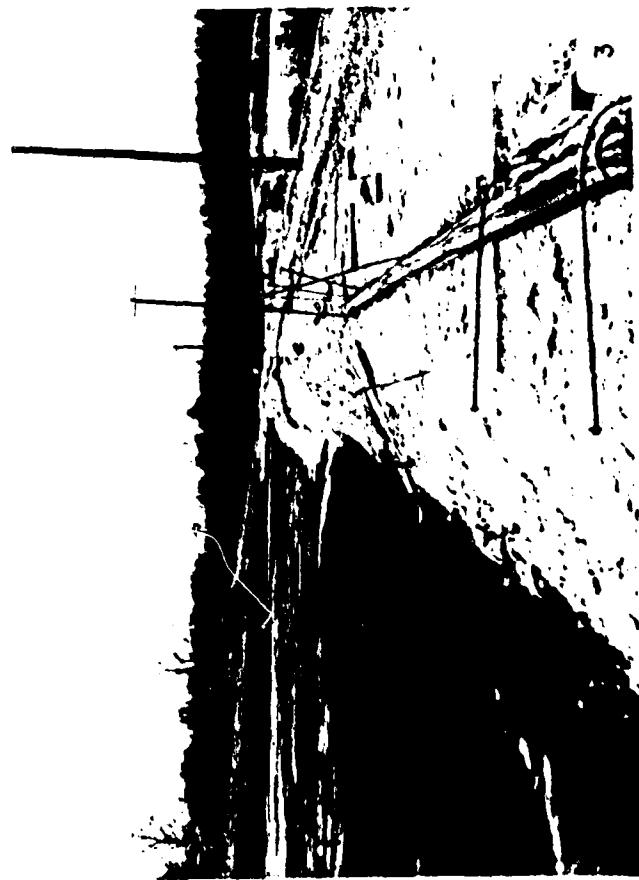
PHOTO 9, 10, 14, 15 & 16  
LOCATIONS ARE NOT SHOWN

|          |          |
|----------|----------|
| DATE:    | MAY 1981 |
| SCALE:   | NONE     |
| DR:      | JF       |
| DWG. NO. | 80138F   |

MINE No. 60 - POND 5  
NATIONAL DAM INSPECTION PROGRAM  
**ACKENHEIL & ASSOCIATES CONSULTING**  
GEO SYSTEMS, INC. ENGINEERS  
1000 BANKSVILLE RD / PITTSBURGH PA 15216

PHOTO  
KEY  
MAP

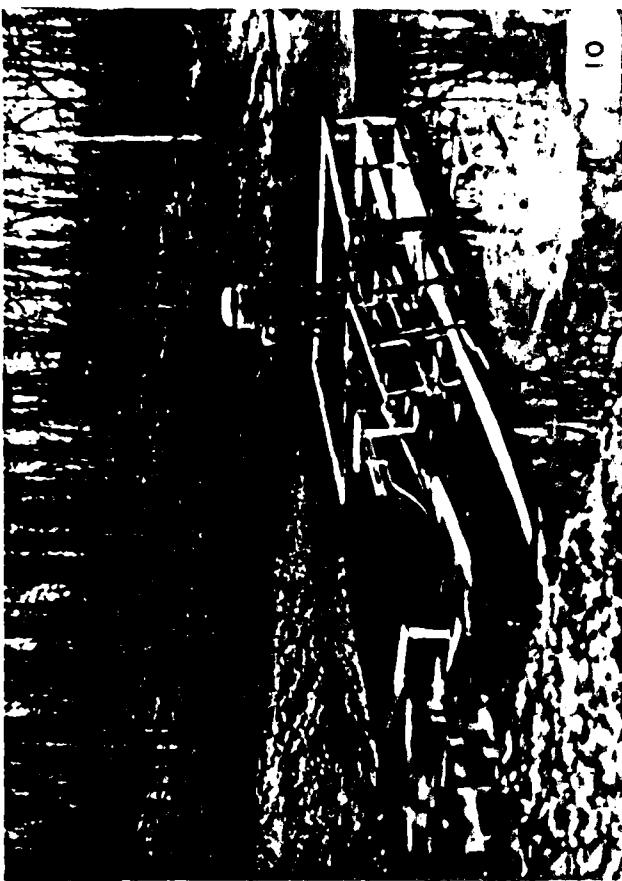
MINE NO 60 - POND 5



MINE NO 60 - POND 5



MINE NO 60 - POND 5



MINE NO. 60 - POND 5



14



16



13



15

C5

#### PHOTO DESCRIPTIONS

- Photo 1 Pond Overview taken from embankment crest.
- Photo 2 Embankment Crest showing slurry inflow pipe.
- Photo 3 Upstream Slope.
- Photo 4 Downstream Slope.
- Photo 5 Downstream Slope and Toe Area. Upper seepage zone is located in the groin area, to the right of the tree in the left center portion of the photo.
- Photo 6 Close Up of Seepage Zone in the Left Groin. Note fine coal refuse ("blackwater") staining.
- Photo 7 Toe of Embankment and Straw Bales.
- Photo 8 Swampy Area Downstream of Toe.
- Photo 9 Upstream End of Pond.
- Photo 10 Outlet Works Pump.
- Photo 11 Principal (and Emergency) Spillway Entrance and silt fence.
- Photo 12 Spillway Discharge Channel.
- Photo 13 Slurry Pipeline Discharge Point.
- Photo 14 Downstream Hazard.
- Photo 15 Downstream Hazard.
- Photo 16 Downstream Hazards.

APPENDIX D  
HYDROLOGY AND HYDRAULICS  
ANALYSES

APPENDIX D  
HYDROLOGY AND HYDRAULICS  
ANALYSES

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

| <u>Parameter</u> | <u>Definition</u>                                | <u>Where Obtained</u>                       |
|------------------|--|---|
| Ct               | Coefficient representing variations of watershed | From Corps of Engineers*                    |
| L                | Length of main stream channel                    | From U.S.G.S.<br>7.5 minute topographic map |
| Lca              | Length on main stream to centroid of watershed   | From U.S.G.S.<br>7.5 minute topographic map |
| Cp               | Peaking coefficient                              | From Corps of Engineers*                    |
| A                | Watershed size                                   | From U.S.G.S.<br>7.5 minute topographic map |

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the spillway and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of an outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

---

\*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately woodland and water surface.

ELEVATION-TOP NORMAL POOL (STORAGE CAPACITY): 1172.5 (187 acre-feet)

ELEVATION-TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1175.1 (217 acre-feet)

ELEVATION-MAXIMUM DESIGN POOL: Unknown

ELEVATION-TOP DAM: 1175.1 (minimum)

OVERFLOW SECTION (Principal and Emergency Spillway)

- a. Elevation 1172.5 (minimum)
- b. Type Broad crested weir in trapezoidal concrete channel
- c. Width 90 feet
- d. Length 12 feet
- e. Location Spillover Eight Abutment
- f. Number and Type of Gates None

OUTLET WORKS AND DRAWDOWN FACILITY

- a. Type Sutmergej pump
- b. Location Near upstream end of pond
- c. Entrance Invert Unknown
- d. Exit Inverts Unknown

HYDROMETEOROLOGICAL GAGES

- a. Type None
- b. Location N/A
- c. Records None

MAXIMUM REPORTED NON-DAMAGING  
DISCHARGE None reported

HEC-1 DAM SAFETY VERSION  
HYDROLOGY AND HYDRAULIC ANALYSIS  
DATA BASE

|   |                    |         |                            |
|---|--------------------|---------|----------------------------|
| NAME OF DAM:  | Mine No. 60-Pond 5 | NDI NO. | PA 01144                   |
| Probable Maximum Precipitation (PMP)  |                    |         | 24.2*                      |
| Drainage Area   |                    |         | 0.05 sq. mi.               |
| Reduction of PMP Rainfall for Data Fit<br>Reduce by 20%, therefore PMP rainfall |                    |         | 0.8 (24.2)<br>=19.4 inches |
| Adjustments of PMF for Drainage Area (Zone 7)                                   |                    |         |                            |
| 6 hrs.  |                    |         | 102%                       |
| 12 hrs.   |                    |         | 120%                       |
| 24 hrs.   |                    |         | 130%                       |
| 48 hrs.   |                    |         | 140%                       |
| Snyder Unit Hydrograph Parameters   |                    |         |                            |
| Zone  |                    |         | 29**                       |
| C <sub>p</sub>  |                    |         | 0.5                        |
| C <sub>t</sub>  |                    |         | 1.6                        |
| L   |                    |         | 0.27 mile                  |
| L <sub>ca</sub>   |                    |         | 0.13 mile                  |
| t <sub>p</sub> = C <sub>t</sub> (L · L <sub>ca</sub> ) <sup>0.3</sup> =         |                    |         | 0.59 hours                 |
| Loss Rates  |                    |         |                            |
| Initial Loss  |                    |         | 1.0 inch                   |
| Constant Loss Rate  |                    |         | 0.05 inch/hour             |
| Base Flow Generation Parameters   |                    |         |                            |
| Flow at Start of Storm  |                    |         | 1.5 cfs/sq.mi=0.08 cfs     |
| Base Flow Cutoff  |                    |         | 0.05 x Q peak              |
| Recession Ratio   |                    |         | 2.0                        |
| Overflow Section Data (Assume Rectangular Cross-Section)                        |                    |         |                            |
| Crest Length  |                    |         | 12 feet                    |
| Crest Elevation   |                    |         | 1172.5                     |
| Freeboard   |                    |         | 2.6 feet                   |
| Discharge Coefficient   |                    |         | 3.09                       |
| Exponent  |                    |         | 1.5                        |
| Discharge Capacity  |                    |         | 155 cfs                    |

---

\* Hydrometeorological Report 33

\*\* Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C<sub>p</sub> and C<sub>t</sub>).

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1000 Banksville Road  
PITTSBURGH, PA. 15216  
(412) 531-7111

Job MINE 60 - ROUNDS Job No. SO138E  
Subject HEC-1 INPUT DATA  
Made By JEB Date 4/17/81 Checked SGM Date 17 APR 85

### LOSS RATE AND BASE FLOW PARAMETERS

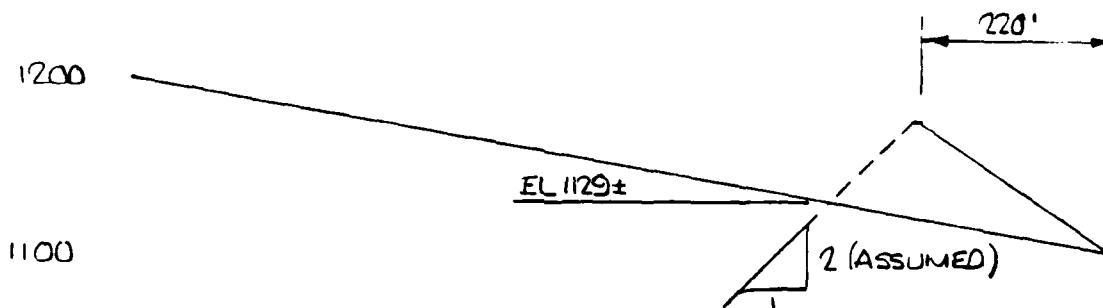
AS RECOMMENDED BY THE CORPS OF ENGINEERS,  
BALTIMORE DISTRICT:

SITZTL = 1 INCH  
LUSTL = 0.5 INCH/HOUR  
SITZTQ = 1.5 CFS/SQ. MI.  
QRCQN = 0.05 (% OF PEAK FLOW)  
RNDZR = 2.0

### ELEVATION - AREA - CAPACITY RELATIONSHIP

AVAILABLE DATA: • USGS 7 1/2 MIN HACKETT QUAD  
PHOTO REVISED 1979  
• PHASE I INVESTIGATION FIELD  
MEASUREMENTS  
• PLATE II AT 1" = 50 FT

ESTIMATED SECTION:



ESTIMATED SURFACE AREA: ASSUME POOL EL = 1165  
(IN 1979, THEN)

$$A_{1165} \approx 9.2 \text{ ACRES}$$

DS

ACKENHEIL & ASSOCIATES  
 GEO Systems, Inc.  
 1000 Banksville Road  
 PITTSBURGH, PA. 15216  
 (412) 531-7111

Job M11JE6J-PANDS Job No. ED138 E  
 Subject HEC 1 INPUT DATA AND PROJECT DATA  
 Made By JEB Date 4/7/81 Checked SGM Date 17 APR. 81

ESTIMATED INITIAL STORAGE: USE CIVIC MODEL

$$V_{1165} = \frac{Abh}{3}$$

$$= \frac{9.2(36)}{3} = 110 \text{ ACRE-FEET}$$

DRED-ELEVATION RELATIONSHIP:

|           |     |      |      |      |
|-----------|-----|------|------|------|
| DRED      | \$A | 0.0  | 9.2  | 20.2 |
| ELEVATION | \$E | 1129 | 1165 | 1200 |

PROJECT DATA:

RESERVOIR SURFACE - CURRENT TOP OF DAM = 1175.1

$$A_{1165} = 9.2 \text{ ACR.} \quad \bar{r}_{65} = 0.5345$$

$$\bar{r}_{72.1} = 0.6088 \Rightarrow A_{75.1} \approx 11.9 \text{ ACR.}$$

$$A_{1200} = 20.2 \text{ ACR.} \quad \bar{r}_{00} = 0.7920$$

- SPILLWAY CREST = 1172.5

$$\bar{r}_{72.5} = 0.5897 \Rightarrow A_{72.5} = 11.2 \text{ ACR.}$$

RESERVOIR STORAGE - CURRENT TOP OF DAM = 1175.1

$$V_{1165} = 110 \text{ ACRE-FEET}$$

$$V_{1175.1} = 110 + 10.1 \left(\frac{1}{3}\right) \left(11.9 + \sqrt{9.2(11.9)} + 9.2\right)$$

$$= 216 \text{ ACRE-FEET}$$

- SPILLWAY CREST = 1172.5

$$V_{1172.5} = 110 + 7.5 \left(\frac{1}{3}\right) (30.55) = 186 \text{ ACRE-FEET}$$

ACKENHEIL & ASSOCIATES  
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1000 Banksville Road  
PITTSBURGH, PA 15216  
(412) 531-7111

Job No MINE 60: POND 5

Job No 80138F

Subject DATA Input

Made By JPat Date 2/3/81 Checked EJM Date 2/3/81

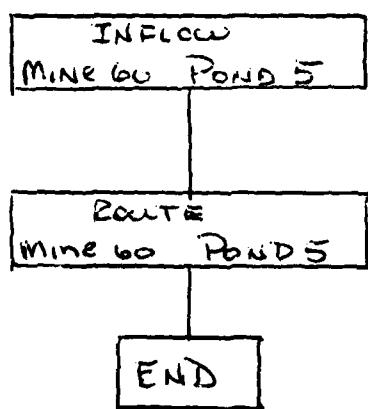
### Dam overtop Parameters

|                                    |           |
|------------------------------------|-----------|
| Top of Dam Elevation (minimum)     | 1175.1    |
| Length of Dam (excluding spillway) | 1100 feet |
| Coefficient of Discharge           | 3.09      |

### Spillway Parameters

|                          |         |
|--------------------------|---------|
| Crest Elevation          | 1172.5  |
| Crest Length             | 12 feet |
| Coefficient of Discharge | 3.09    |

### Program Schedule



\*\*\*\*\*  
FLOOD HYDROGRAPH PACKAGE (HEC-1)  
DAM SAFETY VERSION JULY 1978  
LAST MODIFICATION 26 FEB 79  
\*\*\*\*\*

1 A1 NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS  
2 A2 HYDROLOGIC AND HYDRAULIC ANALYSIS OF SLURRY IMPOUNDMENT #5  
3 A3 PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD  
4 B 300 0 10 0 0 0 0 0 -4 0  
5 B1 5  
6 J 1 2 1  
7 J1 1. .5  
8 K 0 1  
9 K1 INFLOW HYDROGRAPH FOR SLURRY IMPOUNDMENT #5, MINE 60  
10 M 1 1 0.05 0.05 1  
11 P 24.2 102 120 130 140 1  
12 T 1.0 .05  
13 W 0.59 0.5  
14 X -1.5 -0.05 2.0  
15 K 1 2 1  
16 K1 ROUTING AT SLURRY IMPOUNDMENT #5, MINE 60  
17 Y 1 1 -1172.5  
18 Y1 1  
19 \$A 0. 9.2 20.2  
20 \$E1129.0 1165.0 1200.0 1  
21 \$\$1172.5 12.0 3.09 1.5  
22 \$D1175.1 3.09 1.5 1100.  
23 K 99  
24 A  
25 A  
26 A  
27 A  
28 A

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1  
ROUTE HYDROGRAPH TO 2  
END OF NETWORK

\*\*\*\*\*  
FLOOD HYDROGRAPH PACKAGE (HEC-1)  
DAM SAFETY VERSION JULY 1978  
LAST MODIFICATION 26 FEB 79  
\*\*\*\*\*

RUN DATE: 1 MAY 81  
RUN TIME: 8.14.23

NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS  
HYDROLOGIC AND HYDRAULIC ANALYSIS OF SLURRY IMPOUNDMENT #5  
PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

| NO  | NHR | NMIN | IDAY  | JOB SPECIFICATION |       |       |      |      | IPRT | NSTAN |
|-----|-----|------|-------|-------------------|-------|-------|------|------|------|-------|
|     |     |      |       | IHR               | IMIN  | METRC | IPLT | IPRT |      |       |
| 300 | 0   | 10   | 0     | 0                 | 0     | 0     | 0    | -4   | 0    |       |
|     |     |      | JOPER | NWT               | LROPT | TRACE |      |      |      |       |
|     |     |      | 5     | 0                 | 0     | 0     |      |      |      |       |

MULTI-PLAN ANALYSES TO BE PERFORMED  
NPLAN= 1 NRTIO= 2 LRTIO= 1  
RTIOS= 1.00 0.50

\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

## SUB-AREA RUNOFF COMPUTATION

## INFLOW HYDROGRAPH FOR SLURRY IMPOUNDMENT #5, MINE 60

|       |       |       |       |      |      |        |         |       |
|-------|-------|-------|-------|------|------|--------|---------|-------|
| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | I NAME | I STAGE | IAUTO |
| 1     | 0     | 0     | 0     | 0    | 0    | 1      | 0       | 0     |

|                 |      |       |      |       |       |       |       |       |       |  |
|-----------------|------|-------|------|-------|-------|-------|-------|-------|-------|--|
| HYDROGRAPH DATA |      |       |      |       |       |       |       |       |       |  |
| IHYDG           | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |  |
| 1               | 1    | 0.05  | 0.0  | 0.05  | 0.0   | 0.0   | 0     | 1     | 0     |  |

|             |       |        |        |        |        |     |     |  |  |  |
|-------------|-------|--------|--------|--------|--------|-----|-----|--|--|--|
| PRECIP DATA |       |        |        |        |        |     |     |  |  |  |
| SPFE        | PMS   | R6     | R12    | R24    | R48    | R72 | R96 |  |  |  |
| 0.0         | 24.20 | 102.00 | 120.00 | 130.00 | 140.00 | 0.0 | 0.0 |  |  |  |

TRSPC COMPUTED BY THE PROGRAM IS 0.800

|           |       |       |       |       |       |       |       |       |       |       |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| LOSS DATA |       |       |       |       |       |       |       |       |       |       |
| LROPT     | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRIL | CNSTL | ALSMX | RTIMP |
| 0         | 0.0   | 0.0   | 1.00  | 0.0   | 0.0   | 1.00  | 1.00  | 0.05  | 0.0   | 0.0   |

|                      |      |         |      |   |  |  |  |  |  |  |
|----------------------|------|---------|------|---|--|--|--|--|--|--|
| UNIT HYDROGRAPH DATA |      |         |      |   |  |  |  |  |  |  |
| TP=                  | 0.59 | CP=0.50 | NTA= | 0 |  |  |  |  |  |  |

|                 |       |        |       |        |      |  |  |  |  |  |
|-----------------|-------|--------|-------|--------|------|--|--|--|--|--|
| RECEDITION DATA |       |        |       |        |      |  |  |  |  |  |
| STRTO=          | -1.50 | QRCSN= | -0.05 | RTIOR= | 2.00 |  |  |  |  |  |

|   |     |     |     |     |     |     |     |     |    |  |
|---|-----|-----|-----|-----|-----|-----|-----|-----|----|--|
| UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= 0.59 HOURS, CP= 0.50 VOL= 1.00 |     |     |     |     |     |     |     |     |    |  |
| 4.  | 13. | 23. | 26. | 24. | 19. | 16. | 13. | 10. | 9. |  |
| 7.  | 6.  | 5.  | 4.  | 3.  | 3.  | 2.  | 2.  | 1.  | 1. |  |
| 1.  | 1.  | 1.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0. |  |

|                    |        |        |       |          |      |        |       |       |        |      |      |      |        |
|--------------------|--------|--------|-------|----------|------|--------|-------|-------|--------|------|------|------|--------|
| END-OF-PERIOD FLOW |        |        |       |          |      |        |       |       |        |      |      |      |        |
| MC.DA              | HR.MN  | PERIOD | RAIN  | EXCS     | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|                    |        |        |       |          |      |        |       |       |        |      |      |      |        |
| SUM                | 27.10  | 24.68  | 2.42  |          |      |        | 27.10 | 24.68 | 2.42   |      |      |      | 4777.  |
|                    | (688.) | (627.) | (61.) | (135.27) |      |        |       |       |        |      |      |      |        |

## HYDROGRAPH ROUTING

## ROUTING AT SLURRY IMPOUNDMENT #5, MINE 60

|       |       |       |       |      |      |        |         |       |
|-------|-------|-------|-------|------|------|--------|---------|-------|
| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | I NAME | I STAGE | IAUTO |
| 2     | 1     | 0     | 0     | 0    | 0    | 1      | 0       | 0     |

|              |       |     |      |       |      |      |      |  |  |  |
|--------------|-------|-----|------|-------|------|------|------|--|--|--|
| ROUTING DATA |       |     |      |       |      |      |      |  |  |  |
| QLOSS        | CLOSS | Avg | IRES | ISAME | IOPT | IPMP | LSTR |  |  |  |
| 0.0          | 0.0   | 0.0 | 1    | 1     | 0    | 0    | 0    |  |  |  |

|       |       |     |       |     |     |        |        |  |
|-------|-------|-----|-------|-----|-----|--------|--------|--|
| NSTPS | NSTDL | LAG | AMSKK | X   | TSK | STORA  | ISPRAT |  |
| 1     | 0     | 0   | 0.0   | 0.0 | 0.0 | -1173. | 0      |  |

SURFACE AREA= 0. 9. 20.

CAPACITY= 0. 110. 612.

ELEVATION= 1129. 1165. 1200.

|        |       |      |      |      |      |       |      |
|--------|-------|------|------|------|------|-------|------|
| CREL   | SPWID | COQW | EXPW | ELEV | COQL | CAREA | EXPL |
| 1172.5 | 12.0  | 3.1  | 1.5  | 0.0  | 0.0  | 0.0   | 0.0  |

|          |      |      |        |
|----------|------|------|--------|
| DAM DATA |      |      |        |
| TOPEL    | COQD | EXPD | DAMWID |
| 1175.1   | 3.1  | 1.5  | 1100.  |

PEAK OUTFLOW IS 113. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 51. AT TIME 41.67 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS |                 |
|-----------|---------|------|------|-------------------------|-----------------|
|           |         |      |      | RATIO 1<br>1.00         | RATIO 2<br>0.50 |

|               |              |      |              |                |      |
|---------------|--------------|------|--------------|----------------|------|
| HYDROGRAPH AT | 1<br>( 0.13) | 0.05 | 1<br>( 5.77) | 204.<br>2.89)( | 102. |
| ROUTED TO     | 2<br>( 0.13) | 0.05 | 1<br>( 3.21) | 113.<br>1.44)( | 51.  |

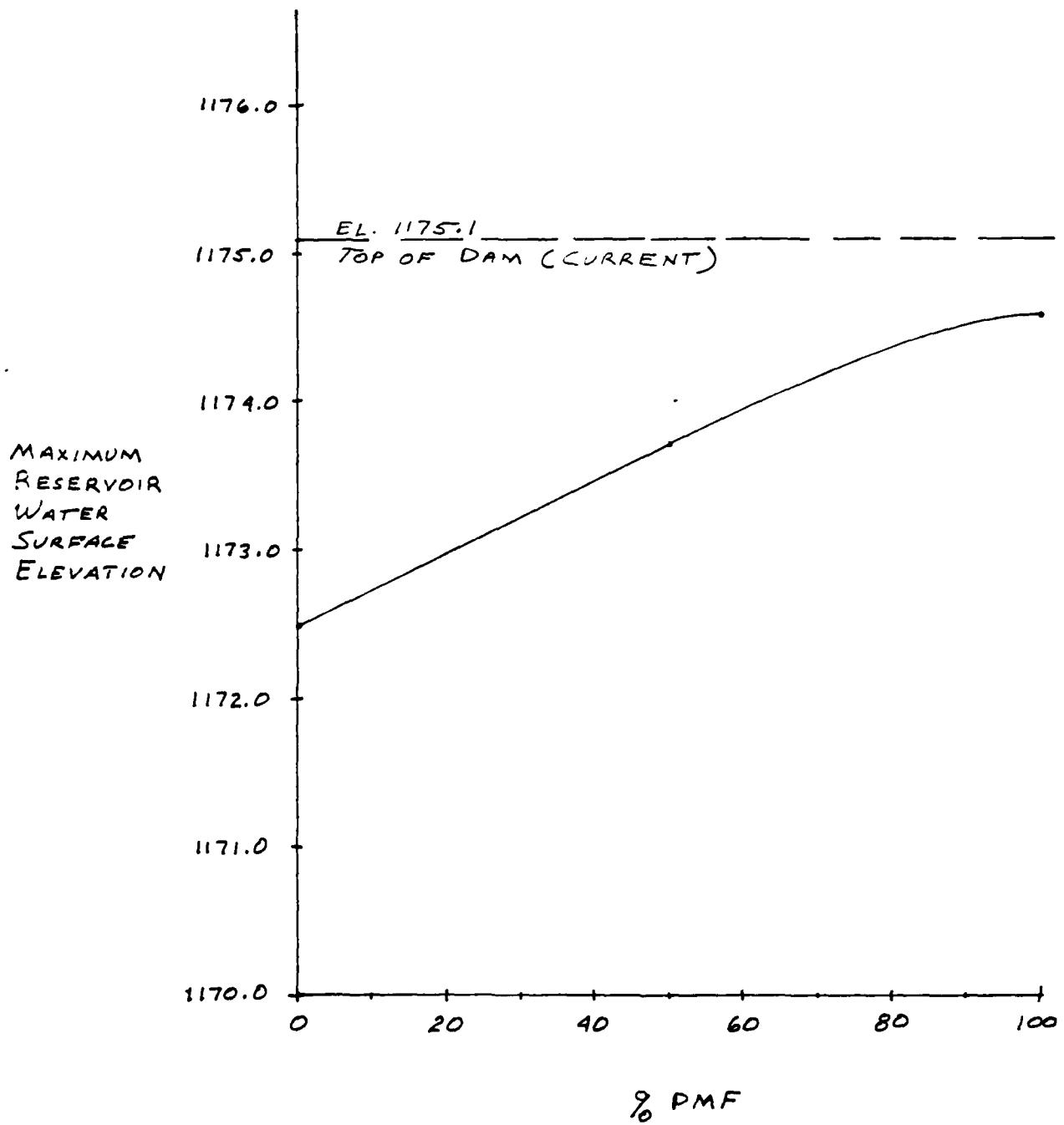
SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 ..... | ELEVATION | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|--------------|-----------|---------------|----------------|------------|
|              | STORAGE   | 1172.50       | 1172.50        | 1175.10    |
|              | OUTFLOW   | 187.          | 187.           | 217.       |
|              |           | 0.            | 0.             | 155.       |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|--------------|----------------------------|------------------------|-----------------------|---------------------|-------------------------|---------------------------|-----------------------|
| 1.00         | 1174.60                    | 0.0                    | 211.                  | 113.                | 0.0                     | 41.50                     | 0.0                   |
| 0.50         | 1173.73                    | 0.0                    | 201.                  | 51.                 | 0.0                     | 41.67                     | 0.0                   |

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Job MINE No. 60 - POND 5 Job No. B013B-F  
Subject HYDROLOGIC PERFORMANCE PLOT  
Made By SGM Date 20 APR 81 Checked T Date 4/20/81

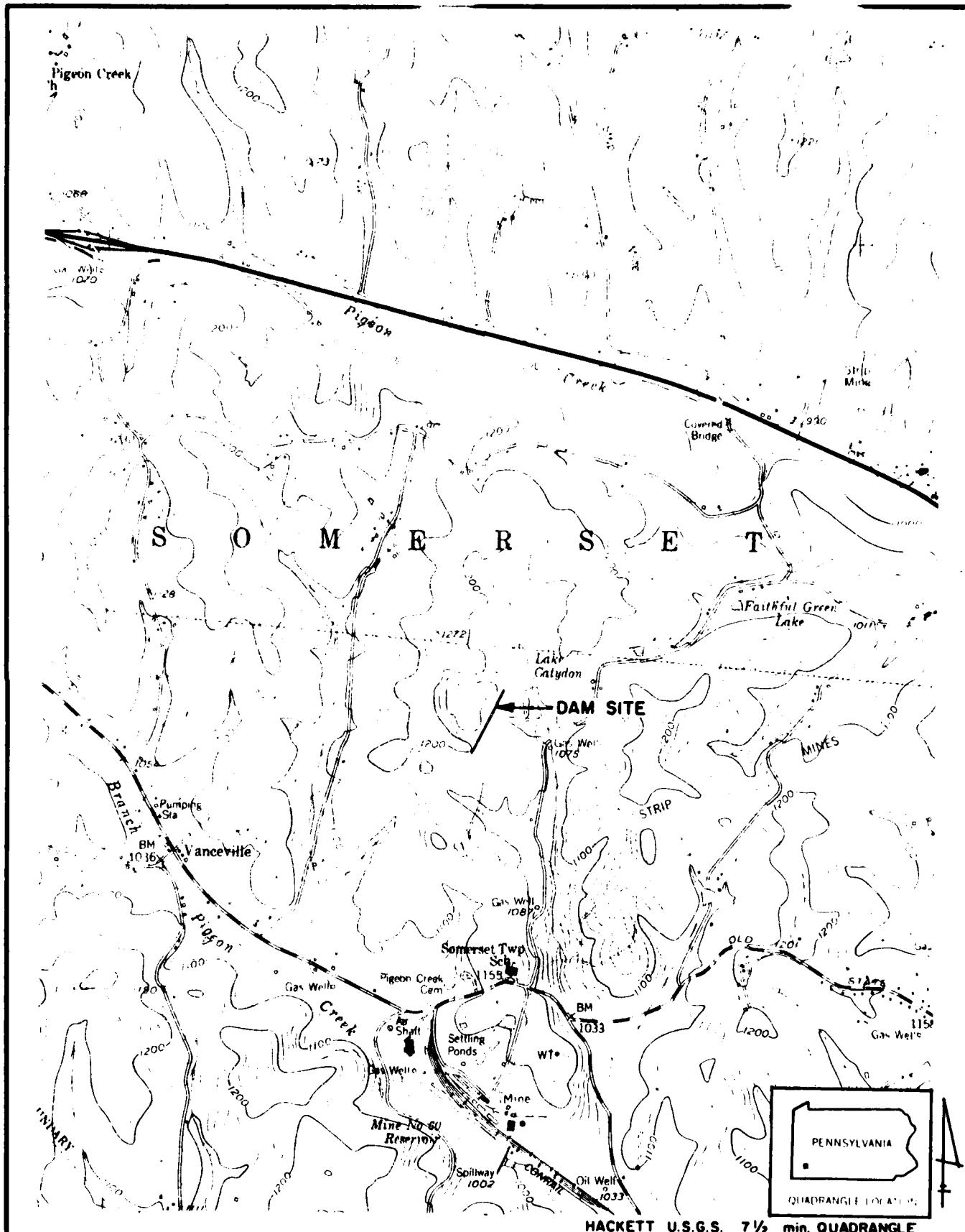


APPENDIX E

PLATES

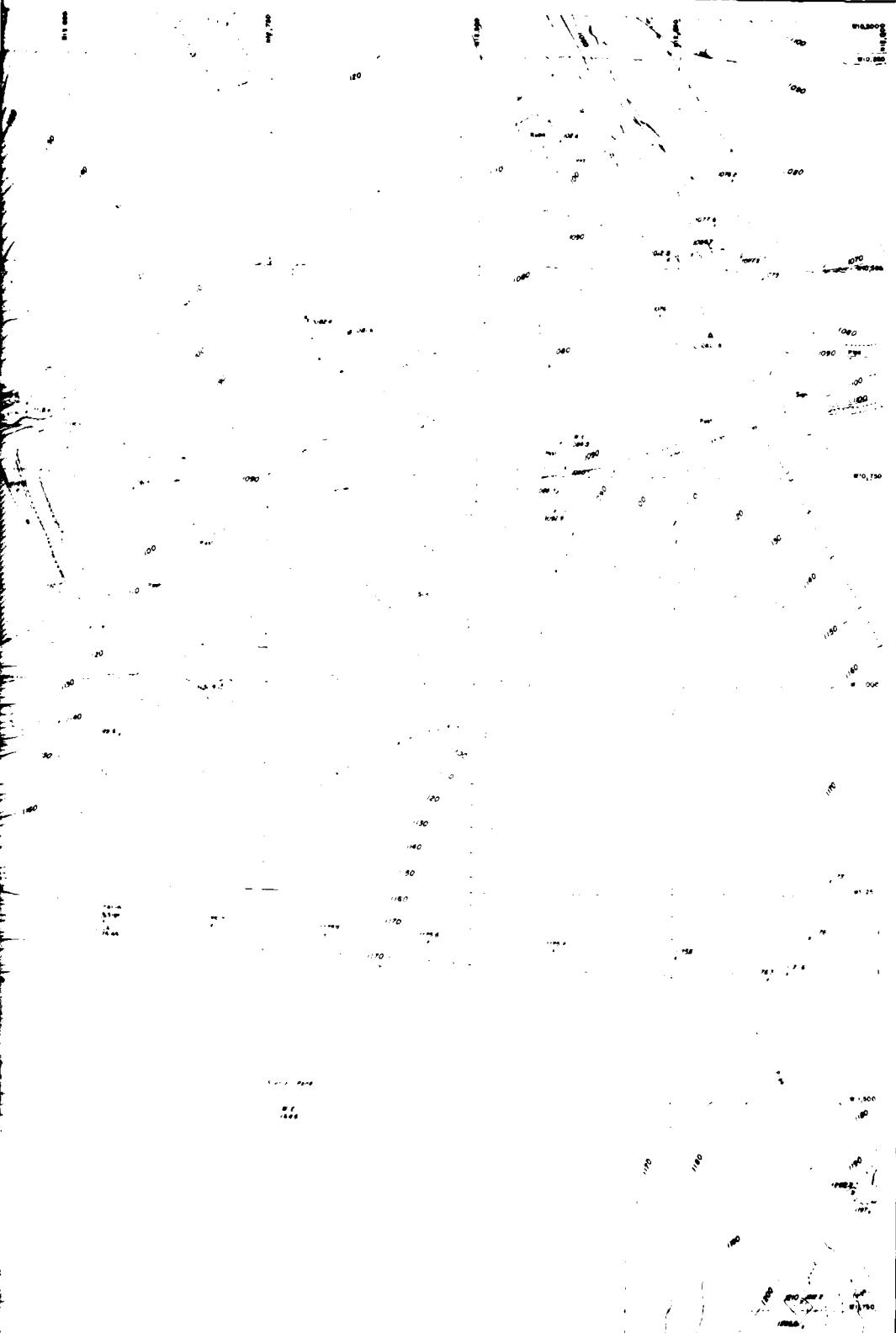
LIST OF PLATES

- Plate I            Regional Vicinity Map.
- Plate II          Topographic Map of Mine 60 Lake Calydone for  
                    Bethlehem Mines Corporation, Ellsworth Division,  
                    dated November 1978.



|                          |  |   |                              |
|--------------------------|--|---|------------------------------|
| <b>DATE:</b> MAY 1981    | <b>MINE No. 60 - POND 5</b>            | <b>ACKENHEIL &amp; ASSOCIATES</b>               | <b>REGIONAL VICINITY MAP</b> |
| <b>SCALE:</b> 1"=2000'   | <b>NATIONAL DAM INSPECTION PROGRAM</b> | <b>GEO SYSTEMS, INC.</b>                        |                              |
| <b>DR:</b> JF <b>CK:</b> | <b>ACKENHEIL &amp; ASSOCIATES</b>      | <b>CONSULTING ENGINEERS</b>                     |                              |
| <b>PLATE I</b>           |  | <b>1000 BANKSVILLE RD./PITTSBURGH, PA 15216</b> |                              |

THIS AIR PHOTOGRAPH IS OWNED BY THE  
PHOTOGRAPHIC SECTION, U.S. AIR FORCE.  
PHOTOGRAPH MADE APRIL 27, 1950 BY L. ROBERT RIBBLE,  
PHOTOGRAPHIC SECTION, WINGATE, PENNSYLVANIA.



TOPOGRAPHIC MAP  
OF  
MINE 60 LAKE CALYDON  
BETHLEHEM MINES CORPORATION  
ELLISWORTH DIVISION  
SCALED 1:250,000 NOVEMBER, 1958  
CONTOUR INTERVAL 5'

1 2 PLATE II

APPENDIX F

GEOLOGY

## GEOLOGY

### Geomorphology

The Mine No. 60-Pond 5 Dam is located within the Pittsburgh Plateau section of the Appalachian Plateau Physiographic Province. This area is characterized by gently folded sedimentary rocks which have been incised by streams to form steep sided valleys. The site is located at the head of an unnamed tributary to the Center Branch of Pigeon Creek. The valley bottom of the unnamed tributary is about 200 feet below the adjacent hilltops. These rounded hilltops are at Elevation 1200 to 1300 feet, and in a regional sense are part of a broad, undulating plateau.

### Structure

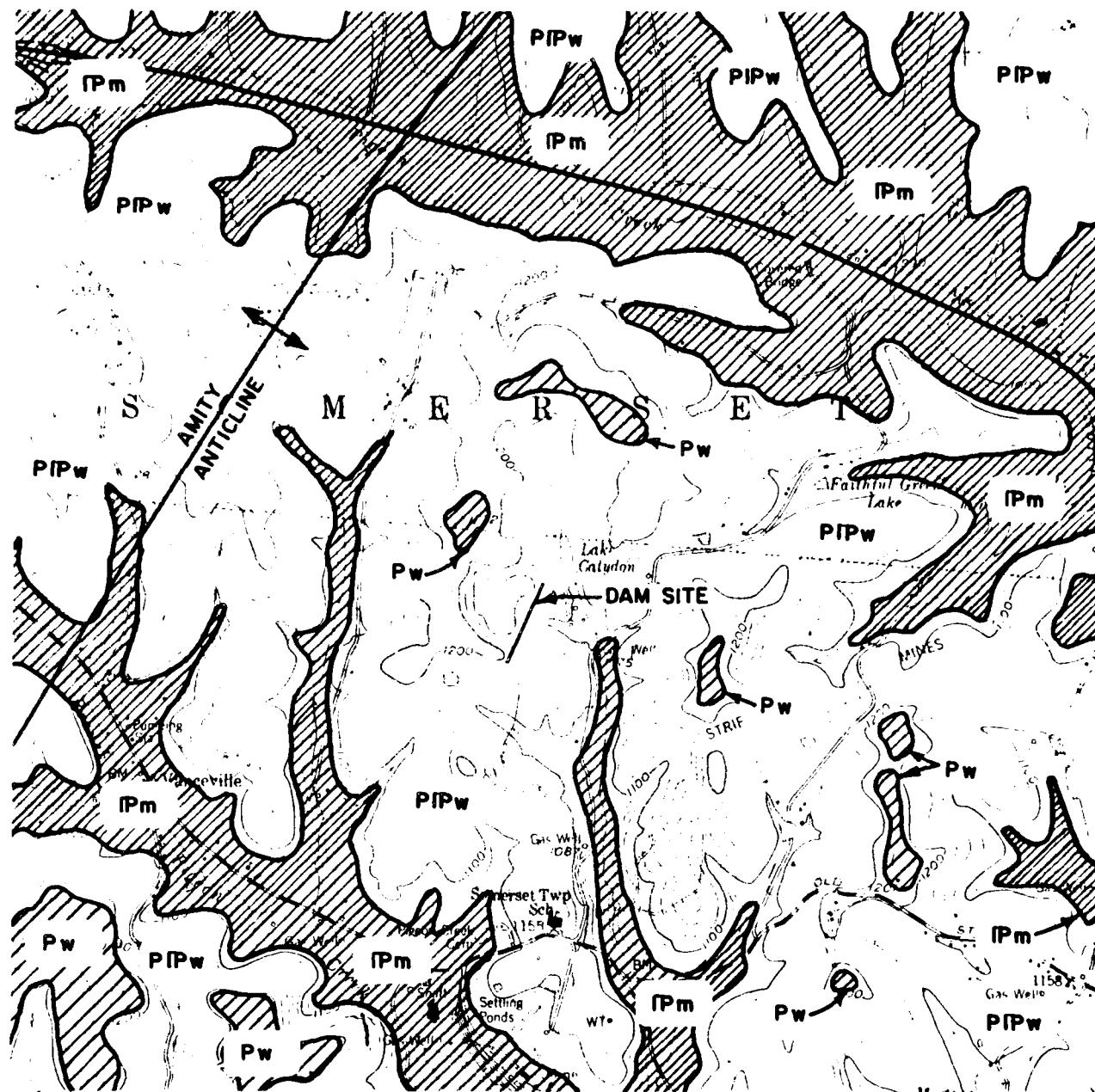
The site lies on the eastern flank of the Amity Anticline, the axis of which plunges to the southwest. Strata in the immediate vicinity of the dam dip to the south at an average rate of about  $0.3^\circ$ . Faulting has not been documented in the area of the dam and no observations were made that would indicate faulting in the rocks outcropping around the dam.

### Stratigraphy

Rocks outcropping in the immediate vicinity of the site belong to the Pennsylvania Age, Casselman and Monongahela Formations and the Permian Age, Waynesburg and Washington Formations. The major rock types in all these formations are cyclic sequences of shale, limestone, sandstone, and coal.

### Mining Activity

The Pittsburgh Coal Seam, the lowermost unit of the Monongahela Formation, lies about 300 feet below the dam and has been extensively deep mined. The Waynesburg Coal Seam, which is the lowermost unit of the Waynesburg Formation, lies beneath the dam and has been unaffected by deep mining.



HACKETT QUADRANGLE, WASHINGTON COUNTY, PENNSYLVANIA

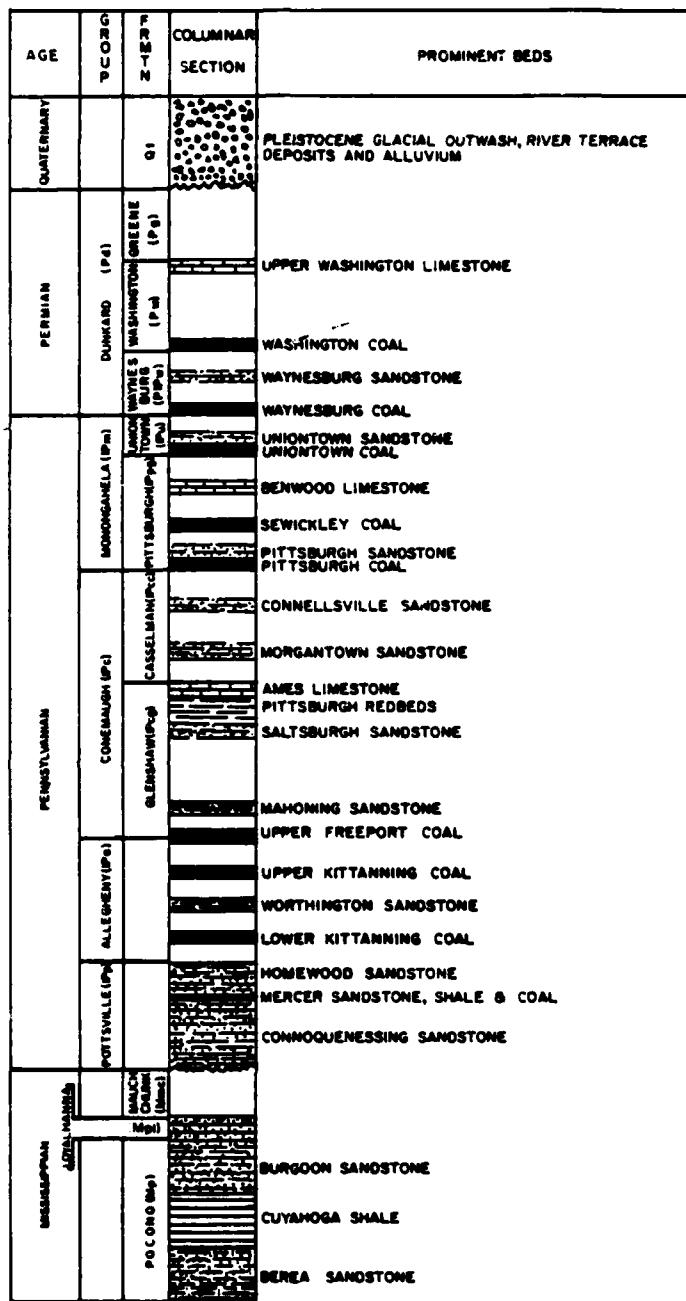
SCALE: 0  $\frac{1}{2}$  MILE  
1:24000

CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL  
FORMATION CONTACT



DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION GEOLOGIC MAP AND CROSS SECTIONS, 1975 and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1975

|                 |   |  |   |
|-----------------|---|--|---|
| DATE: MAY 1981  | MINE No. 60 - POND 5<br>NATIONAL DAM INSPECTION PROGRAM   |  | GEO SYSTEMS, INC.<br>ENGINEERS<br>1000 BANKSVILLE RD./PITTSBURGH PA 15216 |
| SCALE: 1"=2000' | <b>ACKENHEIL &amp; ASSOCIATES</b> CONSULTING<br>ENGINEERS |  |   |
| DR: JF CK:      |   |  | GEOLOGIC<br>MAP   |



DATE: MAY 1981

SCALE: 1" = 360'

DR: JF

CK:

MINE No. 60 - POND 5  
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING  
GEO SYSTEMS, INC.  
ENGINEERS  
1000 BANKSVILLE RD / PITTSBURGH PA 15216

GEOLOGIC  
COLUMN

